DYNAMIC INCENTIVES IN THE SPORT OF KINGS*

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Abstract

Can the reputational incentives that arise in a dynamic setting mitigate standard agency problems, as Fama (1980) suggests? We examine this issue using data from the horse racing industry, where trainers have an incentive to devote more effort to horses they own themselves, but in doing so run the risk that horses owned by clients will be transferred to other stables in the future. We find that client-owned horses perform significantly *better* than trainer-owned horses on average, suggesting that reputational incentives are strong. Moreover, the magnitude of this performance premium increases with the potential importance of trainer reputation. These results suggest that reputational incentives can play a powerful role in disciplining behaviour.

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1. Introduction

A fundamental axiom of economics is that financial incentives are important. Although supporting empirical evidence has been limited due to data constraints, several recent studies suggest that individuals do indeed respond to explicit incentives such as piece rates, bonus plans and profit sharing, e.g., Groves et al (1994), Lazear (2000), McMillan et al (1989). However, not all such incentives are benign. In the standard agency setting, financial considerations can lead to shirking and/or a transfer of resources from principal to agent, e.g., Gruber and Owings (1996).

In contrast to explicit incentives, virtually nothing is known about the power of implicit incentives that arise in a dynamic setting. Fama (1980) and Telser (1980) suggest that the need to maintain a good reputation, thereby protecting future income, can motivate workers and other agents to exert optimum effort, thereby reducing or eliminating agency problems. However, subsequent theoretical work has cast doubt on the general validity of this proposition. In formal models of agent behavior, Holmstrom (1999) and Prendergast (1999) show that effort remains inefficient even when dynamic consequences are fully taken into account; in particular, old agents still choose too little effort while young agents do the opposite. Moreover, Meyer and Vickers (1997) demonstrate that dynamic incentives can be counter-productive if greater effort changes principal expectations in a way that hurts the agent. Nevertheless, the full effects of dynamic incentives are likely to be more complex than is allowed for in these models, so their overall effectiveness in disciplining agent behavior remains an empirical question.

Empirical work has primarily focused on the effects of possible life-cycle variation in the importance of dynamic incentives. For example, Chevalier and Ellison (1999) report that young mutual fund managers are more likely to be sacked for poor fund performance than their older counterparts, consistent with the reputation of the former being more sensitive to recent events. Similarly, Gibbons and Murphy (1992) find that CEO compensation contracts are more performance-sensitive for older workers. However, while such studies are important for showing that employment contracts vary in ways that are consistent with a world in which reputational incentives are strong, they are unable to say much about the extent to which these incentives actually influence behaviour.

In this paper, we attempt to shed some light on this issue by examining a novel example of an agency problem: the potential conflict of interest between owners and trainers in the horse racing industry. This setting has unique advantages: not only is the response to incentives unambiguously measured by horse success, but also the necessary data are publicly available, in contrast to other service professions where reputation is potentially important (e.g., accountancy, law, plumbing and building). And, most importantly, unlike the standard employment situation where managers and workers have a single employer, most trainers prepare horses for a number of owners, with each horse having a unique ownership structure. This feature allows us to examine the link between incentives and performance while holding trainer characteristics constant.

Static and dynamic incentives arise from the singular nature of the owner-trainer relationship. In return for preparing a horse for racing, trainers receive a fixed fee from owners plus a proportion (10% in our sample) of horse winnings. However, they also train horses on their own account, from which they receive 100% of winnings. Such an arrangement creates an obvious incentive for trainers to divert effort and overall training quality from horses owned by outside clients to horses owned by themselves, particularly given the difficulties faced by outside owners in monitoring and assessing trainer inputs. In doing so, however, trainers run the risk of losing future income as client owners become dissatisfied with their horses' performance and consequently transfer them to another stable.

By comparing the success of horses that are trainer-owned with those that are not, our data allow us to explicitly identify the difference in performance between, on the one hand, an expert acting on behalf of a client and, on the other hand, the same expert acting on his own behalf, in a situation where both static and dynamic incentives exist and work in opposite directions. Thus, we can provide a direct assessment of the power of dynamic incentives.

These incentives appear to be strong. On average, client-owned horses perform 20% better than trainer-owned horses, even after controlling for relevant horse and trainer characteristics. While this finding could be due to factors unrelated to dynamic incentives, our main results suggest otherwise. For example, dynamic incentives should be strongest for trainers who are most reliant on their training activities for income purposes, Consistent with this prediction, the 'performance-premium' of client-owned horses is indeed significantly greater for such trainers.

Our analysis and results are closely related to several other studies of incentives and agency problems. Lazear (2000) and Gaynor et al (2004) report that employees and experts respond positively to explicit incentives that affect their current income; our results show that implicit incentives affecting future income can also be important. Levitt and Syverson (2005) and Rutherford et al (2005) compare real estate sales in which the agent acts on behalf of a client with sales where the agent is the seller, and find that agent-owned houses sell for approximately 4% more than others after differences in house characteristics are accounted for. However, because real-estate sales are typically one-shot deals, dynamic incentives are essentially non-existent in these transactions; our work suggests that they can be an important disciplinary device. Finally, Hubbard (1998) finds that private inspectors are more likely to let a vehicle pass an emissions test than government inspectors, despite the former having an incentive to fail vehicles in order to obtain the subsequent repair work. This seems likely to be driven by a desire for repeat business and is thus an example of dynamic incentives at work; our results show that these can even be sufficiently strong to induce agents to put principals' immediate interests ahead of their own.

In the next section, we outline a model that formalises the dynamic incentives facing horse trainers and obtain some testable predictions. Section 3 describes our data sources and some of its properties, while section 4 contains the majority of our results. Section 5 provides some concluding remarks.

2. A simple model of trainer effort allocation

If a trainer exerts effort *e* then a horse has winnings

$$w = a + be + x,$$

where a and b are constants and x is a zero-mean random variable with distribution function F (and density function f). We assume that trainers are paid a flat fee of *h* if they train a horse which they do not own, and receive all the horse's winnings from horses they do own. In addition, the trainer receives the certain income stream L_t from activities unrelated to training.

There are two seasons - the present (time 0) and the future (time 1) - and realisations of *x* are independent across these two dates. Any client-owned horse prepared by a trainer in the current season must have winnings exceeding some threshold $\bar{w}$ if the trainer is to be retained

(and receive the fee *h*) for next season. That is, if the trainer exerts effort *e* into training a horse which he does not own, then he gets to train the horse next season if and only if

$$a + be + x \geq \bar{w} \Leftrightarrow x \geq \bar{w} - a - be.$$

This occurs with probability

$$1 - F(\bar{w} - a - be).$$

To keep things simple, consider the situation of a trainer with two horses, one of which he owns while the other is owned by someone else. He has total effort 1 able to be allocated to training each season, and e_t is the effort allocated to his own horse in season t. Assuming the flat fee structure, he will optimally set $e_1 = 1$ regardless of whether he trains one or two horses next season. Then his income levels in each of the two seasons are:

$$\begin{aligned} I_0 &= (a + be_0 + x_0 + h) + L_0 \\ I_1 &= (a + b + x_1 + h) + L_1 \quad \text{with probability } 1 - F(\bar{w} - a - b(1-e_0)) \\ &= (a + b + x_1) + L_1 \quad \text{with probability } F(\bar{w} - a - b(1-e_0)) \end{aligned}$$

The trainer's choice of effort e_o is governed by a utility function U(I). If next season's expected utility is discounted by the factor δ, his expected utility from the two seasons is

$$E_0[U(a + be_0 + x_0 + h + L_0)] + \delta F(\bar{w} - a - b(1-e_0))E_1[U((a + b + x_1) + L_1)]$$
$$+ \delta(1 - F(\bar{w} - a - b(1-e_0)))E_1[U((a + b + x_1 + h) + L_1)]$$

where $E_t[.]$ denotes current expectations about x_t. This is maximized by choosing e_0 such that:

$$E_0[U'((a + be_0 + x_0 + h) + L_0] - \delta\Delta\, f(\bar{w} - a - b(1-e_0)) = 0$$
$$E_0[U''((a + be_0 + x_0 + h) + L_0] - \delta\Delta\, f'(\bar{w} - a - b(1-e_0)) < 0$$

where $\Delta \equiv E_1[U((a + b + x_1 + h) + L_1)] - E_1[U((a + b + x_1) + L_1)] > 0$.

The first-order condition reveals a simple tradeoff between static and dynamic concerns. On the one hand, the trainer has an incentive to allocate effort to his own horse this season, since he receives 100% of its winnings. On the other hand, too little effort allocated to the client-owned horse this season makes it unlikely that its winnings will reach the threshold $\bar{w}$, and therefore unlikely that he will receive the fixed fee h next season. Note that if $\bar{w} = 0$, then the latter condition disappears and the trainer sets $e_0 = 1$. However, the optimal e_0 is decreasing in $\bar{w}$, so $e_0 < 1$ for $\bar{w} > 0$. For high enough $\bar{w}$, $e_0 < 1/2$, and the trainer allocates more effort to the outside horse. Since expected performance is increasing in effort, we have:

Claim 1: *The performance difference between trainer- and client-owned horses is negative if and only if reputational concerns are sufficiently weak.*

Claim 1 states that we can infer the relative strengths of static and dynamic incentives by comparing the racecourse performance of trainer-owned horses with that of client-owned horses. If the former group do better than the latter, then static incentives dominate dynamic considerations, and vice versa.

Of course, even if trainer-owned horses perform better than their client-owned counterparts, this need not mean that dynamic incentives are non-existent. Differentiating the first order condition with respect to δ shows that

$$\frac{\partial e_0}{\partial \delta} = \frac{\Delta f(\bar{w} - a - b(1-e_0))}{b\{E_0[U''((a + be_0 + x_0 + h) + L_0)] - \delta\Delta\, f'(\bar{w} - a - b(1-e_0))\}} < 0$$

which says that trainers for whom the future is more important allocate relatively more effort to horses they do not own. One way to assess this empirically is along age dimensions: trainers nearing retirement have fewer seasons remaining in which to earn training fees than younger trainers, so the latter seem likely to be more concerned about the future, i..e, have a higher δ. This suggests:

Claim 2: Relative to trainer-owned horses, client-owned horses perform better in the stables of young trainers than in the stables of old trainers.

Similarly, differentiating the first order condition with respect to L_1 shows that

$$\frac{\partial e_0}{\partial L_1} = \frac{\delta f(\bar{w} - a - b(1-e_0))(\partial \Delta / \partial L_1)}{b\{E_0[U''((a + be_0 + x_0 + h) + L_0)] - \delta \Delta f'(\bar{w} - a - b(1-e_0))\}} > 0$$

since $\partial\Delta/\partial L_1$ must be negative due to $U'' < 0$. This says that trainers who are less dependent on future training income allocate relatively more effort to horses they own. In practice, trainers who support themselves with income from non-training sources, and thus have high L_1, are likely to manage only a small stable. Thus:

Claim 3: Relative to trainer-owned horses, client-owned horses perform better in large stables than in small stables.

3. Data

Our data set contains details on every horse that competed in NZ harness races during the 1997-98 and 2002-03 seasons.[1] Starting with the first race at the first meeting of the 1997-98 season, we record the age, sex, trainer, winnings and ownership details of the winning horse. Using the Harness Racing New Zealand website, we then track this horse through the rest of the season, recording performance details for each start plus any changes in trainer or ownership. We repeat this procedure for every other horse in the same race, then move to the second and subsequent races at the same meeting, and so on through all meetings and races held during the 1997-98 season. Finally, we repeat the whole exercise for the 2002-03 season in order to obtain two independent samples.[2]

In 1997-98, there were 237 meetings at which 2350 races were contested by 3448 horses who raced a total of 17708 times; for 2002-03, these figures were 232 meetings, 2350 races, 3263 horses and 18335 horse-races. Some horses changed trainers over the season, or had their trainer's ownership share altered. Each such change was treated as a different horse, leading to a final dataset of 4087 horses in 1997-98 and 3861 in 2002-03. The respective trainer numbers are 984 and 852.

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1 The NZ racing season runs from 1 August to 31 July.
2 Only 63 horses raced in both seasons.

Table 1 provides some summary statistics for the horses in our sample. In both seasons, the average horse is between four and five years old, races six or seven times, earns $4000-$5000 for its two to three owners, and has an almost 60% chance of being male. However, some of these characteristics vary considerably across horses: the standard deviations for the number of races and the number of owners are almost as large as their respective means, while the standard deviations for earnings are almost three times as large as the corresponding means.

[Insert Table 1 about here]

Our primary interest is in the relationship between trainer ownership and horse performance. Although we know the identity of each horse's owners, we do not know their ownership shares. Thus, we distinguish between horses in which the trainer has some ownership share and those that are completely client-owned.[3] The last row of Table 1 shows that trainers have an ownership share in a little over one-third of the horses in our sample.

To measure performance, we use two variables. The first, commonly used in the industry itself, measures the regularity with which the horse is a place getter:

$$\text{consistency ratio} = \frac{9*\text{number of firsts} + 5*\text{number of seconds} + 3*\text{number of thirds}}{\text{number of races during season}}$$

The second measures the extent to which a horse achieves its maximum-possible earnings:

$$\text{Earnings-Maximum Earnings Ratio} = \frac{\text{stake earnings during the season}}{\text{sum of winning stakes from all races during season}}$$

The two performance measures are quite highly correlated, but the latter gives more weight to high-stakes races. This feature recognises that trainers may use their experience and knowledge to prepare a horse for the big occasion by racing its way to fitness in lesser races. If this strategy is successful, the horse's consistency ratio would be low, but its winning earnings proportion would be high.

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3 A finer distinction between horses in which the trainer is a part-owner and those in which he has the full ownership share yields similar results.

Table 2 reports the mean values of these performance measures for the two categories of ownership outlined above. Intriguingly, client-owned horses perform significantly better than trainer-owned horses on average: the former are 25%-35% more consistent and 21%-33% better at realising their potential winnings. As trainers have a strong explicit incentive to devote more time and effort to horses they own, these results are suggestive of powerful reputational forces at work: horses not owned by trainers do not just do as well as trainer-owned horses, they actually do much better. However, other variables that potentially affect horse performance, such as horse age and sex and trainer quality, are also correlated with trainer-ownership in our sample, so we need to employ multiple regression models to disentangle these effects.

[Insert Table 2 about here]

4. Regression Analysis

We estimate regression models of the general form

$$\text{Performance} = a_0 + a_1 * \text{OUTSIDE\_OWNER} + \sum_i b_i * \text{CONTROL}_i + \varepsilon$$

where OUTSIDE_OWNER = 1 if the trainer is not one of the horse's owners and zero otherwise, and CONTROL_i is a control variable that potentially influences horse performance over the course of a season.[4] We use the following controls:

Horse Age. Although young horses (two and three year-olds) lack experience, which could be expected to worsen performance, they typically race only against each other, thereby nullifying this effect. Horse speed and stamina typically declines beyond three-four years of age, so we expect our performance measures to be inversely related to age. In our season samples, horse age is approximately four months greater for trainer-owned horses.

[4] We do not consider race-specific determinants of performance such as barrier draw, track conditions, and race distance, since the impact of these varies from horse to horse and, in any event, can be expected to even out over multiple starts. However, we implicitly take acount of these variables in cases where they might be important by subsequently restricting our analysis to horses that race at least five times during the season.

Horse Sex. Male horses are typically more robust than females, which is likely to result in better performance. We therefore employ an indicator variable that is equal to one if the horse is male and zero otherwise.

Trainer Quality. All else equal, better training will result in better performance. To measure trainer quality, we use average stake earnings of horses in the trainer's stable over the previous five seasons.

Trainer quality is also an important control for another reason. In contrast to the assumption that is implicit in our analysis, ownership structure is a choice variable and is thus endogenous rather than exogenous. Trainers might therefore be expected to use their superior information to purchase ownership only in the horses most likely to succeed. This would suggest that Table 2 understates the true power of reputational incentives. However, the results in Table 2 are also consistent with a world in which wealthy client owners, facing weaker financial constraints than trainers, purchase the highest-quality horses who subsequently perform best.[5] One way to control for this possibility would be to include a variable measuring the initial sales price of each horse in our sample. Unfortunately, many horses are sold privately (or retained by the breeder), so this information is not available. However, client owners possessing a valuable horse are unlikely to entrust its care to a poorly-performing trainer, so our trainer-quality variable should help control for this endogoneity problem.[6]

Table 3 presents a series of regression results corresponding to different seasons, different performance measures, and different model specifications. In columns (1) and (3) of each panel, we control for horse age and sex, which lowers the estimated impact of outside ownership compared with the simple mean differences reported in Table 2. For example, the average improvement in consistency for horses with no trainer ownership in 1997-98 is now 0.023, compared with 0.029 in Table 2. Nevertheless, these differences remain significant at the 1% level or better.

In columns (2) and (4) of each panel, we add the trainer quality variable. This has a more substantial effect on the impact of outside ownership, with the ownership coefficient becoming insignificant at conventional levels in one specification (although remaining highly

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5 This is likely to be mitigated to some extent by the New Zealand handicapping system where races generally involve horses of similar quality, and by our performance variables which emphasize performance within-class rather than the class of race in which the horse races.

6 Indeed, for both seasons, the mean five-season winnings of a horse's trainer is about $90,000 greater on average if the horse is not owned by the trainer, i.e., a client-owned horse is more likely to be in the stable of a high-quality trainer.

significant in the others). On average, horses that trainers do not own are now only 12%-16% more consistent and 9%-17% better at realising their potential winnings than trainer-owned horses.

[Insert Table 3 about here]

Although the control variables are not our primary focus, it is comforting to know that their coefficients seem sensible. In all specifications, male horses and horses with trainers who have been successful in the past do better and older horses do worse.

Our samples contain a number of horses who race only a few times in their respective seasons. In any given race, a horse may experience good or bad luck affecting its performance, so the presence of lightly-raced horses in our data is likely to introduce significant noise into the analysis. In case it also causes bias, we re-estimate the Table 3 models with a restricted sample of horses that raced at least five times during the season. The results from this procedure appear in Table 4. This increases the size and statistical significance of the ownership variable coefficients (all are now signficantly positive at conventional levels), and raises the R-squared values.

[Insert Table 4 about here]

Overall, the results in Tables 3 and 4 provide further evidence that reputation incentives are not just strong for horse trainers, but strong enough to induce 'over-effort' in horses owned by outside clients. Even after controlling for characteristics such as age, sex and trainer quality, client-owned horses out-perform trainer-owned horses by economically significant amounts on average, particularly when sparsely-raced horses are excluded.

However, it is possible that our results actually reveal little about the power of reputational incentives, perhaps because our ownership variable is correlated with some unknown determinant of horse performance, or alternatively because of trainer 'self-selection'. That is, individuals who put their clients' interests ahead of their own may be disproportionately inclined to become horse trainers.[7] In that case, the performance advantage enjoyed by client-

[7] See Lott and Broners (1993) for discussion of a similar effect among politicians.

owned horses would be reputation-based, but for different reasons than envisaged by Fama (1980) or our model of section 2. If the results above do indeed indicate strong reputational forces at work, then the propensity of trainers to favour outside-owned horses should systematically vary with the importance of reputation. That is, the ownership coefficient in the regressions above should be higher for horses that are trained by individuals for whom the establishment and maintenance of a good reputation are most important.

Following Claims 2 and 3 above, we use trainer age and stable size as two indicators of the importance of reputation. Young trainers have many seasons ahead of them, so establishment of a good reputation is important if they hope to attract clients regularly over their career. Trainers with large stables are likely to be most dependent on training activities for their income and hence most concerned with maintaining a good reputation.

Although the Harness Racing New Zealand database does not report trainer age, we are able to identify when a trainer is first licensed.[8] To proxy for age, we therefore create an indicator variable that equals one if the horse's trainer holds a professional license and has less than 10 years experience.[9] To proxy for stable size, we use the number of horses in the trainer's stable that raced at least once during the season. Although this is a lower bound on actual stable size, the two should be closely related. For both these variables, we create interaction variables with the ownership variable and estimate regressions of the form

$$\begin{aligned} \text{Performance} = {} & a_0 + a_1 * \text{OUTSIDE\_OWNER} \\ & + a_2 * \text{OUTSIDE\_OWNER} * \text{IMPORTANCE} \\ & + \sum_i b_i * \text{CONTROL}_i + \varepsilon \end{aligned}$$

where IMPORTANCE denotes the stable size or trainer age proxy. In these models, a_1 measures the ownership effect associated with trainers who care little about reputation, while a2 measures the additional ownership effect for horses prepared by trainers who attach greater importance to reputation.

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8 The HRNZ database begins in the 1985-86 season, so it is possible that we identify some trainers as having commenced training after that season when they in fact trained prior to it before taking a break for one or more seasons. Industry enquiries suggest that nny bias resulting from this problem is likely to be small.

9 Not all trainers hold a professional license. Others hold a 'license to train', which restricts the number of outside-owned horses able to be trained.

Tables 5 (full sample) and 6 (restricted sample) summarise the results of these regressions. In the full sample, the coefficient on the ownership variable is significantly *negative* in four of the six regressions using the consistency ratio as the dependent variable, while it is generally indistinguishable from zero in the earnings ratio regressions. As this coefficient now captures the effect of outside ownership for those horses with trainers who have low values of the reputation proxies, these findings are consistent with reputational incentives being weakest for those who care least about future income opportunities from training. In the restricted sample, more of the coefficients are positive, but they are insignificant in eight of the 12 specifications.

[Insert Tables 5 and 6 about here]

Stronger evidence is provided by the second row of each panel in both tables. In all cases, the interaction of outside ownership with stable size is positive and significant at the 1% level or better. That is, the performance advantage of outside-owned horses is greatest for horses trained in stables that are most reliant on maintaining a good reputation. Comparing these coefficients with those on the ownership variable alone in specifications (1) and (3) in both panels of Table 5, we see that the overall impact of outside ownership on performance is negative for stables consisting of less than 7-10 horses and positive thereafter. Bigger stables place greater emphasis (at least relatively) on the interests of their clients, just as the reputation story suggests.

The interaction of trainer age with outside ownership provides much more mixed results. Most of the coefficients are insignificantly different from zero, three are significantly positive, and one is significantly negative. One scenario consistent with this evidence is where inexperience initially encourages some younger trainers to "try it on" (i.e., attempt to take advantage of their owners), but also where, as time goes on and learning occurs, these trainers are forced to either exit the industry or mend their ways. If this were the case, then our sample would consist of young trainers that varied considerably in their propensity to deal diligently with the horses of outside owners, and old trainers who were far more homogeneous. Such a pattern would account for the lack of evidence for trainer age as a proxy for reputation.

5. Concluding Remarks

Can the reputational incentives that arise in a dynamic setting mitigate standard agency problems, as suggested by Fama (1980)? Our results in this paper suggest that such incentives can indeed play a powerful role in disciplining behaviour, at least for agents whose future income opportunities are potentially sensitive to their reputation status. Although horse trainers benefit from allocating more effort to horses that they own, the average performance of these horses is inferior to that of horses they do not own. Moreover, this performance differential is significantly stronger among horses that belong to stables for which reputation is likely to be particularly important.

Of course, it is interesting to speculate about the generality of these results and their potential applicability to other settings. One reason why dynamic incentives are likely to be strong among horse trainers is the unregulated nature of the labor market in which they operate: horses can, and do, transfer from one stable to another literally overnight. Most labor markets do not work like this, making future income far less dependent on reputation. Other expert-client markets are most similar to the trainer-owner relationship - it is usually simple enough to fire one's accountant, lawyer or plumber - but performance is not always so easy to observe as at the racetrack. Nevertheless, our results provide some idea of what is possible in the right circumstances. Clearly, the ability of long-term reputational incentives to discipline agents cannot simply be dismissed as a theoretical curiosity.

There remains some unresolved questions. First, there may be unobservable heterogeneity in trainers that our analysis has not accounted for. For example, the trainers who predominantly prepare their own horses may differ in a systematic way from trainers who predominantly look after the horses of other people. This problem also arises in the Duggan and Levitt (2005) and Rutherford et al (2005) studies of real estate agents: their finding that estate agents get higher prices for houses they sell on their own behalf may simply indicate that the agents who sell their house (presumably in order to buy a better one) are predominantly the best agents, in which case it is unsurprising that they obtain a higher-than-predicted price. In our case, it should be possible to get around this difficulty by constructing owned and not-owned portfolios for *each trainer* and using the performance differential as the dependent variable. Second, there remains the deeper question of why reputational incentives are strong for horse trainers, i.e., does a failure to invest in the development of a good reputation have

adverse consequences? This would require data on the hiring-firing decisions of owners with respect to trainers.

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Table 1

Descriptive Statistics

This table provides summary information about the horses in our dataset. Trainer-owned horses are those where the trainer has at least a partial ownership share.

	1997-98				2002-03			
Horse Characteristic	Mean (Std Dev)	Median	Max	Min	Mean (Std Dev)	Median	Max	Min
Age	4.6 (1.6)	4	11	2	4.4 (1.5)	4	13	2
Number of races during season	6.7 (5.8)	5	43	1	7.0 (5.8)	5	45	1
Number of owners	2.6 (2.2)	2	10	1	2.7 (2.3)	2	10	1
Season earnings ($)	4154 (12553)	725	302460	0	5035 (14343)	1250	396723	0
Male (%)	59	-	-	-	58	-	-	-
Trainer-owned (%)	39	-	-	-	36	-	-	-

Table 2

Ownership and Performance I: Comparison of Means

The first two columns in each panel report the mean performance of horses in which the trainer has an ownership stake and those in which he does not. The third column calculates the difference and reports the p-value (in parentheses) of a test that this is zero.

	1997-98			2002-03		
Variable	Trainer Owned	Client Owned	Difference	Trainer Owned	Client Owned	Difference
Consistency Ratio	0.117	0.146	-0.029 (< 0.01)	0.120	0.162	-0.042 (< 0.01)
Earnings-Maximum Earnings Ratio	0.089	0.108	-0.019 (< 0.01)	0.095	0.126	-0.032 (< 0.01)

Table 3

Ownership and Performance II: Regression Analysis (Full Sample)

Regressions of horse performance on ownership and horse and trainer characteristics. Client Owner equals one if the horse is not owned by a trainer and zero otherwise. Male equals one if the horse is male and zero otherwise. Trainer quality is the average stakes won by the horse's trainer over the previous five seasons (in $00000). Terms in parentheses are p-values.

	1997-98 (n = 4087)		2002-03 (n = 3861)	
	Panel A: Dependent Variable = Consistency Ratio			
Variable	(1)	(2)	(3)	(4)
Constant	0.185 (0.00)	0.173 (0.00)	0.202 (0.00)	0.183 (0.00)
Client Owner	0.023 (0.00)	0.014 (0.02)	0.034 (0.00)	0.019 (0.00)
Age	-0.019 (0.00)	-0.017 (0.00)	-0.024 (0.00)	-0.020 (0.00)
Male	0.038 (0.00)	0.036 (0.00)	0.047 (0.00)	0.042 (0.00)
Trainer Quality		0.011 (0.00)		0.020 (0.00)
R^2	0.04	0.06	0.05	0.08
	Panel B: Dependent Variable = Earnings-Maximum Earnings Ratio			
Constant	0.142 (0.00)	0.134 (0.00)	0.151 (0.00)	0.138 (0.00)
Client Owner	0.015 (0.00)	0.008 (0.10)	0.026 (0.00)	0.016 (0.00)
Age	-0.015 (0.00)	-0.013 (0.00)	-0.017 (0.00)	-0.015 (0.00)
Male	0.030 (0.00)	0.029 (0.00)	0.037 (0.00)	0.034 (0.00)
Trainer Quality		0.007 (0.00)		0.013 (0.00)
R^2	0.03	0.04	0.04	0.06

Table 4

Ownership and Performance III: Regression Analysis (Restricted Sample)

Regressions of horse performance on ownership structure and horse and trainer characteristics for horses that have five or more starts in the season. All variables are as described in Table 3. Terms in parentheses are p-values.

	1997-98 (n = 4087)		2002-03 (n = 3861)	
	Panel A: Dependent Variable = Consistency Ratio			
Variable	(1)	(2)	(3)	(4)
Constant	0.247 (0.00)	0.235 (0.00)	0.225 (0.00)	0.207 (0.00)
Client Owner	0.031 (0.00)	0.021 (0.00)	0.040 (0.00)	0.024 (0.00)
Age	-0.025 (0.00)	-0.023 (0.00)	-0.023 (0.00)	-0.020 (0.00)
Male	0.036 (0.00)	0.034 (0.00)	0.039 (0.00)	0.035 (0.00)
Trainer Quality		0.011 (0.00)		0.018 (0.00)
R^2	0.09	0.12	0.09	0.13
	Panel B: Dependent Variable = Earnings-Maximum Earnings Ratio			
Constant	0.182 (0.00)	0.176 (0.00)	0.154 (0.00)	0.144 (0.00)
Client Owner	0.017 (0.00)	0.012 (0.03)	0.027 (0.00)	0.018 (0.00)
Age	-0.018 (0.00)	-0.017 (0.00)	-0.014 (0.00)	-0.013 (0.00)
Male	0.026 (0.00)	0.024 (0.00)	0.027 (0.00)	0.025 (0.00)
Trainer Quality		0.006 (0.00)		0.010 (0.00)
R^2	0.07	0.08	0.07	0.09

Table 5

Ownership and Performance IV: Reputation Effects (Full Sample)

This table estimates the impact that ex-ante measures of trainer reputation have on the performance-ownership relationship. Stable size is the number of horses raced by the horse's trainer during the season; trainer experience equals one if the horse's trainer holds a professional license and has less than 10 years experience. All regressions also include the variables appearing in Tables 3 and 4, but these coefficients are not reported. Terms in parentheses are p-values.

	1997-98 (n = 4087)			2002-03 (n = 3861)		
Panel A: Dependent Variable = Consistency Ratio						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Client Owner	-0.017	0.011	-0.019	-0.001	0.020	0.004
	(0.02)	(0.07)	(0.02)	(0.89)	(0.00)	(0.68)
Client Owner* Stable Size	0.002		0.002	0.001		0.002
	(0.00)		(0.00)	(0.00)		(0.00)
Client Owner* Trainer Experience		0.014	0.016	-0.004	-0.012	
		(0.12)	(0.08)	(0.63)	(0.15)	
R^2	0.07	0.06	0.07	0.09	0.08	0.09
Panel B: Dependent Variable = Earnings-Maximum Earnings Ratio						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Client Owner	-0.015	0.007	-0.016	-0.001	0.016	0.003
	(0.02)	(0.20)	(0.00)	(0.99)	(0.01)	(0.66)
Client Owner* Stable Size	0.002		0.002	0.001		0.001
	(0.00)		(0.00)	(0.00)		(0.00)
Client Owner* Trainer Experience		0.008	0.010	-0.002	-0.008	
		(0.27)	(0.20)	(0.78)	(0.24)	
R^2	0.06	0.05	0.06	0.09	0.06	0.06

Table 6

Ownership and Performance V: Reputation Effects (Restricted Sample)

This table estimates the impact that ex-ante measures of trainer reputation have on the performance-ownership relationship for the sample of horses that have five or more races during the season. Variables are as described in Table 5. All regressions also include the variables appearing in Tables 3 and 4, but these coefficients are not reported. Terms in parentheses are p-values.

	1997-98 (n = 2155)			2002-03 (n = 2157)		
Panel A: Dependent Variable = Consistency Ratio						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Client Owner	-0.010	0.016	-0.015	0.008	0.027	0.013
	(0.20)	(0.02)	(0.10)	(0.31)	(0.00)	(0.00)
Client Owner* Stable Size	0.002		0.002	0.001		0.001
	(0.00)		(0.00)	(0.00)		(0.00)
Client Owner* Trainer Experience		0.025	0.028	-0.009	-0.016	
		(0.02)	(0.01)	(0.31)	(0.06)	
R^2	0.14	0.12	0.14	0.13	0.13	0.09
Panel B: Dependent Variable = Earnings-Maximum Earnings Ratio						
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Client Owner	-0.009	0.009	-0.011	0.008	0.020	0.010
	(0.24)	(0.10)	(0.15)	(0.20)	(0.01)	(0.12)
Client Owner* Stable Size	0.001		0.001	0.001		0.001
	(0.00)		(0.00)	(0.01)		(0.00)
Client Owner* Trainer Experience		0.015	0.017	-0.010	-0.015	
		(0.07)	(0.04)	(0.11)	(0.02)	
R^2	0.09	0.08	0.09	0.09	0.06	0.09